

No.

8700146



THE UNITED STATES OF AMERICA

TO ALL TO WHOM THESE PRESENTS SHALL COME:

**The Ohio State University,
Ohio Agricultural Research and Development Center**

Whereas, THERE HAS BEEN PRESENTED TO THE

Secretary of Agriculture

AN APPLICATION REQUESTING A CERTIFICATE OF PROTECTION FOR AN ALLEGED NOVEL VARIETY OF SEXUALLY REPRODUCED PLANT, THE NAME AND DESCRIPTION OF WHICH ARE CONTAINED IN THE APPLICATION AND EXHIBITS, A COPY OF WHICH IS HEREUNTO ANNEXED AND MADE A PART HEREOF, AND THE VARIOUS REQUIREMENTS OF LAW IN SUCH CASES MADE AND PROVIDED HAVE BEEN COMPLIED WITH, AND THE TITLE THERETO IS, FROM THE RECORDS OF THE PLANT VARIETY PROTECTION OFFICE, IN THE APPLICANT(S) INDICATED IN THE SAID COPY, AND WHEREAS, UPON DUE EXAMINATION MADE, THE SAID APPLICANT(S) IS (ARE) ADJUDGED TO BE ENTITLED TO A CERTIFICATE OF PLANT VARIETY PROTECTION UNDER THE LAW.

NOW, THEREFORE, THIS CERTIFICATE OF PLANT VARIETY PROTECTION IS TO GRANT UNTO THE SAID APPLICANT(S) AND THE SUCCESSORS, HEIRS OR ASSIGNS OF THE SAID APPLICANT(S) FOR THE TERM OF *eighteen* YEARS FROM THE DATE OF THIS GRANT, SUBJECT TO THE PAYMENT OF THE REQUIRED FEES AND PERIODIC REPLENISHMENT OF VIABLE BASIC SEED OF THE VARIETY IN A PUBLIC REPOSITORY AS PROVIDED BY LAW, THE RIGHT TO EXCLUDE OTHERS FROM SELLING THE VARIETY, OR OFFERING IT FOR SALE, OR REPRODUCING IT, IMPORTING IT, OR EXPORTING IT, OR USING IT IN PRODUCING A HYBRID OR DIFFERENT THEREFROM, TO THE EXTENT PROVIDED BY THE PLANT VARIETY PROTECTION ACT. UNITED STATES SEED OF THIS VARIETY (1) SHALL BE SOLD BY VARIETY NAME ONLY AS CERTIFIED SEED AND (2) SHALL CONFORM TO THE NUMBER OF GENERATIONS SPECIFIED BY THE OWNER OF THE RIGHTS. (84 STAT. 1542, AS AMENDED, 7 U.S.C. 2321 ET SEQ.)

WHEAT

'Cardinal'

In Testimony Whereof, I have hereunto set my hand and caused the seal of the Plant Variety Protection Office to be affixed at the City of Washington, D. C. this 30th day of November in the year of our Lord one thousand nine hundred and eighty-eight.

Attest:

Kenneth H. Evans
Commissioner
Plant Variety Protection Office
Agricultural Marketing Service

Richard E. Lyng
Secretary of Agriculture

U.S. DEPARTMENT OF AGRICULTURE
AGRICULTURAL MARKETING SERVICE

FORM APPROVED: OMB NO. 0581-0055

APPLICATION FOR PLANT VARIETY PROTECTION CERTIFICATE

(Instructions on reverse)

Application is required in order to determine if a plant variety protection certificate is to be issued (7 U.S.C. 2421). Information is held confidential until certificate is issued (7 U.S.C. 2426).

1. NAME OF APPLICANT(S) Ohio State University, Ohio Agricultural Research and Development Center		2. TEMPORARY DESIGNATION OH244	3. VARIETY NAME Cardinal
4. ADDRESS (Street and No. or R.F.D. No., City, State, and Zip Code) 1680 Madison Ave. Wooster, OH, 44691		5. PHONE (Include area code) 216-263-3700	FOR OFFICIAL USE ONLY PVPO NUMBER 8700146
6. GENUS AND SPECIES NAME <u>Triticum aestivum</u> L.	7. FAMILY NAME (Botanical) Graminae		FILING DATE <u>June 8, 1987</u> TIME <u>9:30</u> <input checked="" type="checkbox"/> A.M. <input type="checkbox"/> P.M.
8. KIND NAME Soft Red Winter Wheat	9. DATE OF DETERMINATION 9/6/85		AMOUNT FOR FILING \$ <u>1800.00</u> DATE <u>June 8, 1987</u> FEE RECEIVED AMOUNT FOR CERTIFICATE \$ <u>200.00</u> DATE <u>Sept. 19, 1988</u>
10. IF THE APPLICANT NAMED IS NOT A "PERSON," GIVE FORM OF ORGANIZATION (Corporation, partnership, association, etc.) Agricultural Experiment Station			
11. IF INCORPORATED, GIVE STATE OF INCORPORATION			12. DATE OF INCORPORATION

13. NAME AND ADDRESS OF APPLICANT REPRESENTATIVE(S), IF ANY, TO SERVE IN THIS APPLICATION AND RECEIVE ALL PAPERS

Dr. H. N. Lafever
Agronomy Department
Ohio State University, Ohio Agricultural Research & Development Center
Wooster, OH, 44691
PHONE (Include area code): 216-263-3886

14. CHECK APPROPRIATE BOX FOR EACH ATTACHMENT SUBMITTED

- a. ☒ Exhibit A, Origin and Breeding History of the Variety (See Section 52 of the Plant Variety Protection Act.)
b. ☒ Exhibit B, Novelty Statement.
c. ☒ Exhibit C, Objective Description of Variety (Request form from Plant Variety Protection Office.)
d. ☒ Exhibit D, Additional Description of Variety.
e. ☒ Exhibit E, Statement of the Basis of Applicant's Ownership.

15. DOES THE APPLICANT(S) SPECIFY THAT SEED OF THIS VARIETY BE SOLD BY VARIETY NAME ONLY AS A CLASS OF CERTIFIED SEED? (See Section 83(a) of the Plant Variety Protection Act.) ☒ Yes (If "Yes," answer items 16 and 17 below) ☐ No

16. DOES THE APPLICANT(S) SPECIFY THAT THIS VARIETY BE LIMITED AS TO NUMBER OF GENERATIONS?

☒ Yes ☐ No

17. IF "YES" TO ITEM 16, WHICH CLASSES OF PRODUCTION BEYOND BREEDER SEED?

☒ Foundation ☒ Registered ☒ Certified

18. DID THE APPLICANT(S) PREVIOUSLY FILE FOR PROTECTION OF THE VARIETY IN THE U.S.?

☐ Yes (If "Yes," give date)☒ No

19. HAS THE VARIETY BEEN RELEASED, OFFERED FOR SALE, OR MARKETED IN THE U.S. OR OTHER COUNTRIES?

U.S., September, 1986 (Sold as Foundation generation seed to producers ☒ Yes (If "Yes," give names of countries and dates)
of Registered or Certified class seed)

☐ No

20. The applicant(s) declare(s) that a viable sample of basic seeds of this variety will be furnished with the application and will be replenished upon request in accordance with such regulations as may be applicable.

The undersigned applicant(s) is (are) the owner(s) of this sexually reproduced novel plant variety, and believe(s) that the variety is distinct, uniform, and stable as required in Section 41, and is entitled to protection under the provisions of Section 42 of the Plant Variety Protection Act.

Applicant(s) is (are) informed that false representation herein can jeopardize protection and result in penalties.

SIGNATURE OF APPLICANT

Howard N. Lafever (Breeder)

DATE

3/30/87

SIGNATURE OF APPLICANT

Frederick E. Hutchinson Director
FORM WA-470 (7-84) (Edition of 3-84 is obsolete.) The Ohio State University

DATE

4/7/87
May 19, 1987

1

Exhibit AOrigin and Breeding History of the Variety

1. Cardinal (previously designated OH 244) originated at The Ohio State University, Ohio Agricultural Research and Development Center from the complex cross: Logan 2^{*}/3/Va 63-52-12/Logan//Blueboy. The final cross was made in 1971 and designated 2071. Cardinal was first selected in 1974 as an F₃ plant and designated 2071ABC-12. It was reselected in 1981 in the F₁₀ generation as described below.
2. Breeder seed of Cardinal consists of the progeny of 39 F₁₀ plants selected for uniformity in 1981-1984 and bulked after 1984 harvest to constitute Breeder seed. Breeder seed was seeded in fall, 1984. Foundation generation seed was produced in the 1985-86 crop season with the first distribution of Foundation generation seed made in the fall, 1986 to producers of Registered or Certified classes of seed.
3. Cardinal appears to be very uniform and homozygous as observed in the field over the past six seasons. This would be expected of the progeny of phenotypically identical plants selected in the F₁₀ and reexamined for uniformity in the F₁₁ through the F₁₃ generations. (Originally 60 F₁₀ plants were selected as being identical in the F₁₀ generation, however, continued observation for uniformity in the F₁₁ through F₁₃ generations resulted in the progeny of only 39 of these being bulked after harvest of the F₁₃ generation in 1984.)
4. Cardinal appears to be very stable and true breeding as evidenced by agronomic and pathological examination of the F₁₀ through F₁₃ generations in special purification and increase nurseries.
5. ~~Variants observed during the development of the variety were few in number and of various, non-repeating types. In the 1986 Foundation generation production fields some off-types were observed including short, awned plants, plants with long tip awns and lax heads. Occasionally reported were awnless, red chaff types also. The total of all such types did not exceed .0125%.~~

Roguing of all observed off-types was performed four times in the Breeder seed increase of 1984-85 and three times in the Foundation generation increase of 1985-86.

Criteria for selection during the multiplication and purification process in the F₁₁-F₁₃ generations allowed no variance from complete uniformity. If one off-type plant was observed in a 10' row, that plant was either rogued or the entire row dropped from further increase. If two or more off-type plants were observed within a row, the row was eliminated from further increase.

6. The variety was selected primarily for high yielding ability and extreme straw strength. Additionally, selection for all other important agronomic, pathologic, and quality traits were exercised. The variety was selected in comparison to popular varieties in Ohio, namely, Adena, Becker, Hart, Titan, and Tyler.

See letter with
amendment dated
7/11/86
SS

AMENDMENT TO PARAGRAPH 5, EXHIBIT A.



Ohio Agricultural Research
and Development Center

Department of Agronomy
1680 Madison Avenue
Wooster, OH 44691-4096
Phone 216-263-3878

July 1, 1988

Dr. Kenneth H. Evans, Commissioner
Plant Variety Protection Office
National Agricultural Library Bldg., Rm 500
Beltsville, MD 20705

Dear Ken:

During the past three growing seasons I have had the opportunity to inspect several breeder seed fields of Cardinal soft red winter wheat. In the course of these inspections it has become obvious that a phenotypic variant exists in the variety which was not previously described, thus, I am hereby requesting an amendment be added to Exhibit A, Section 5, paragraph 1 of our Application for Plant Variety Protection Certificate (PV #8700146, Wheat) to read as follows:

5. Variants observed during the development and increase of the variety were few in number and of various, non-repeating types with the following exceptions: In the past three seasons inspection of breeder seed fields have revealed the presence of awned, red and white chaffed plants, plants with long tip awns and lax heads, and plants which are red chaffed and awnless. The total of all such types does not exceed .3% (3/1000).

(Paragraphs 2 and 3 unchanged.)

Thank you for your consideration.

Sincerely yours,

A handwritten signature in cursive script that reads 'Howard N. Lavever'.

Howard N. Lavever
Professor

HNL:je

Exhibit BNovelty Statement and Botanical Description of the Variety

Cardinal is an awnless cultivar, but possesses apical awnlets. It is midseason in maturity and is a moderately short cultivar, averaging 5 cm shorter than Tyler, 2.5 cm shorter than Hart and Titan, but is 12.5 cm taller than Becker. Cardinal has exhibited excellent straw strength in Ohio and region-wide tests, exceeding all currently grown cultivars except Becker and GR 855 in straw strength. Winterhardiness of Cardinal is excellent, equaling that of the best currently grown cultivars in Ohio tests and exceeding numerous soft wheat cultivars except Charmony in severe tests in the upper Midwest.

Test weight of Cardinal is high, averaging .5 lb/bu below that of Hart. The Yield record of Cardinal is outstanding.

The USDA Soft Wheat Quality Laboratory, Wooster, Ohio in evaluations of samples of Cardinal has found it to possess excellent milling and baking quality.

Cardinal possesses excellent resistance to leaf rust (Puccinia recondita), but is only moderately resistant to powdery mildew (Erysiphe graminis). It is also very resistant to wheat spindle streak mosaic virus (WSSM). Cardinal possesses resistance to races GP, A, C, and F races of Hessian fly (Mayetola destructor, Say) imparted by the H₃ gene.

Cardinal also possesses excellent tolerance to soil aluminum, often a problem in acid eastern soils, being nearly as tolerant as Seneca which is thought to be the most tolerant soft red winter wheat ever grown in the eastern soft wheat region.

Cardinal has dark green foliage. At maturity its large fusiform heads are held mostly erect and possess white chaff.

Cardinal most closely resembles Titan, however, it averages 1 inch shorter and two days earlier in heading. It also exhibits greater leaf rust resistance, WSSM resistance, and a more erect growth habit as a juvenile plant.

U. S. DEPARTMENT OF AGRICULTURE
AGRICULTURAL MARKETING SERVICE
LIVESTOCK, MEAT, GRAIN AND SEED DIVISION
BELTSVILLE, MARYLAND 20785

EXHIBIT C
(Wheat)

OBJECTIVE DESCRIPTION OF VARIETY

WHEAT (TRITICUM SPP.)

INSTRUCTIONS: See Reverse.

NAME OF APPLICANT(S) <u>Ohio State University, Ohio Agricultural</u> <u>Research and Development Center</u>	FOR OFFICIAL USE ONLY
ADDRESS (Street and No. or R.F.D. No., City, State, and ZIP Code) <u>1680 Madison Avenue</u> <u>Wooster, OH, 44691</u>	PVPD NUMBER <u>8700146</u>
	VARIETY NAME OR TEMPORARY DESIGNATION <u>Cardinal</u>

Place the appropriate number that describes the varietal character of this variety in the boxes below.

Place a zero in first box (e.g., 089 or 09) when number is either 99 or less or 9 or less.

1. KIND:

1 1 = COMMON 2 = DURUM 3 = EMMER 4 = SPELT 5 = POLISH 6 = POULARD 7 = CLUB

2. TYPE:

2 1 = SPRING 2 = WINTER 3 = OTHER (Specify) _____ 1 1 = SOFT 3 = OTHER (Specify) _____
2 = HARD _____

2 1 = WHITE 2 = RED 3 = OTHER (Specify) _____

3. SEASON - NUMBER OF DAYS FROM EMERGENCE TO:

228 FIRST FLOWERING 233 LAST FLOWERING

4. MATURITY (50% Flowering):

 NO. OF DAYS EARLIER THAN 1 = ARTHUR 2 = SCOUT 3 = CHRIS
05 NO. OF DAYS LATER THAN 1 4 = LEMHI 5 = NUGAINES 6 = LEEDS

5. PLANT HEIGHT (From soil level to top of head):

091 CM. HIGH
00 CM. TALLER THAN 1
 CM. SHORTER THAN 1 = ARTHUR 2 = SCOUT 3 = CHRIS
4 = LEMHI 5 = NUGAINES 6 = LEEDS

6. PLANT COLOR AT BOOTING (See reverse):

3 1 = YELLOW GREEN 2 = GREEN 3 = BLUE GREEN

7. ANTHUR COLOR:

1 1 = YELLOW 2 = PURPLE

8. STEM:

1 Anthocyanin: 1 = ABSENT 2 = PRESENT 2 Waxy bloom: 1 = ABSENT 2 = PRESENT
2 Hairiness of last internode of rachis: 1 = ABSENT 2 = PRESENT 1 Internodes: 1 = HOLLOW 2 = SOLID
04 NO. OF NODES (Originating from node above ground) 22 CM. INTERNODE LENGTH BETWEEN FLAG LEAF AND LEAF BELOW

9. AURICLES:

1 Anthocyanin: 1 = ABSENT 2 = PRESENT 2 Hairiness: 1 = ABSENT 2 = PRESENT

10. LEAF:

2 Flag leaf at booting stage: 1 = ERECT 2 = RECURVED 2 Flag leaf: 1 = NOT TWISTED 2 = TWISTED
3 = OTHER (Specify): _____
1 Hairs of first leaf sheath: 1 = ABSENT 2 = PRESENT 2 Waxy bloom of flag leaf sheath: 1 = ABSENT 2 = PRESENT
12 MM. LEAF WIDTH (First leaf below flag leaf) 22 CM. LEAF LENGTH (First leaf below flag leaf):

11. HEAD:

☐ Density: 1 = LAX 2 = DENSE☐ Shape: 1 = TAPERING 2 = STRAP 3 = CLAVATE 4 = OTHER (Specify) _____☐ Awnedness: 1 = AWNLESS 2 = APICALLY AWNLETED 3 = AWNLETED 4 = AWNEED☐ Color at maturity: 1 = WHITE 2 = YELLOW 3 = PINK 4 = RED 5 = BROWN 6 = BLACK 7 = OTHER (Specify) _____☐ 8.7 CM. LENGTH☐ 5 MM. WIDTH

12. GLUMES AT MATURITY:

☐ Length: 1 = SHORT (CA. 7 mm.) 2 = MEDIUM (CA. 8 mm.) 3 = LONG (CA. 9 mm.)☐ Width: 1 = NARROW (CA. 3 mm.) 2 = MEDIUM (CA. 3.5 mm.) 3 = WIDE (CA. 4 mm.)☐ Shoulder shape: 1 = WANTING 2 = OBLIQUE 3 = ROUNDED 4 = SQUARE 5 = ELEVATED 6 = APICULATE☐ Beak: 1 = OBTUSE 2 = ACUTE 3 = ACUMINATE

13. COLEOPTILE COLOR:

☐ 3 1 = WHITE 2 = RED 3 = PURPLE

14. SEEDLING ANTHOCYANIN:

☐ 1 1 = ABSENT 2 = PRESENT (trace?)

15. JUVENILE PLANT GROWTH HABIT:

☐ 1 1 = PROSTRATE 2 = SEMI-ERECT 3 = ERECT

16. SEED:

☐ 1 Shape: 1 = OVATE 2 = OVAL 3 = ELLIPTICAL☐ 1 Cheek: 1 = ROUNDED 2 = ANGULAR☐ 2 Brush: 1 = SHORT 2 = MEDIUM 3 = LONG☐ 1 Brush: 1 = NOT COLLARED 2 = COLLARED☐ 3 Phenol reaction (See instructions): 1 = IVORY 2 = FAWN 3 = LT. BROWN 4 = BROWN 5 = BLACK☐ 3 Color: 1 = WHITE 2 = AMBER 3 = RED 4 = PURPLE 5 = OTHER (Specify) _____☐ 7.5 MM. LENGTH☐ 3.5 MM. WIDTH☐ 3 8 GM. PER 1000 SEEDS

17. SEED CREASE:

☐ 1 Width: 1 = 60% OR LESS OF KERNEL 'WINOKA' 2 = 80% OR LESS OF KERNEL 'CHRIS' 3 = NEARLY AS WIDE AS KERNEL 'LEMHI'☐ 1 Depth: 1 = 20% OR LESS OF KERNEL 'SCOUT' 2 = 35% OR LESS OF KERNEL 'CHRIS' 3 = 50% OR LESS OF KERNEL 'LEMHI'

18. DISEASE: (0 = Not Tested, 1 = Susceptible, 2 = Resistant)

☐ 0 STEM RUST (Races)☐ 2 LEAF RUST (Races) (Field)☐ 0 STRIPE RUST (Races)☐ 0 LOOSE SMUT☐ 1 POWDERY MILDEW☐ 0 BUNT☐ 2 OTHER (Specify) WSSM virus

19. INSECT: (0 = Not Tested, 1 = Susceptible, 2 = Resistant)

☐ 0 SAWFLY☐ 0 APHID (Bydv.)☐ 0 GREEN BUG☐ 0 CEREAL LEAF BEETLE☐ OTHER (Specify) _____HESSIAN FLY
RACES:☐ 2 GP☐ 2 A☐ 1 B☐ 2 C☐ 1 D☐ 1 E☐ 2 F☐ 1 G

20. INDICATE WHICH VARIETY MOST CLOSELY RESEMBLES THAT SUBMITTED:

CHARACTER	NAME OF VARIETY	CHARACTER	NAME OF VARIETY
Plant tillering	Titan	Seed size	Titan
Leaf size	Adena	Seed shape	Titan
Leaf color	Titan	Coleoptile elongation	Logan
Leaf carriage	Adena	Seedling pigmentation	Titan

INSTRUCTIONS

GENERAL: The following publications may be used as a reference aid for the standardization of terms and procedures for completing this form:

(a) L.W. Briggie and L. P. Reitz, 1963, Classification of Triticum Species and Wheat Varieties Grown in the United States, Technical Bulletin 1278, United States Department of Agriculture.(b) W.E. Walls, 1965, A Standardized Phenol Method for Testing Wheat Seeds for Varietal Purity, contribution No. 28 to the handbook of seed testing prepared by the Association of Official Seed Analysts. (See attachment.)

LEAF COLOR: Nickerson's or any recognized color fan should be used to determine the leaf color of the described variety.

Exhibit DAdditional Description of the Variety

Heads of Cardinal plants are best described as dense (Item 11, Exhibit C), however, they are actually more nearly intermediate in density than many varieties described as dense. Heads are mostly erect at maturity.

The variety is apically awnleted with tip awns measuring up to 20-23 mm in length.

Plants of the Cardinal variety are robust, tiller somewhat profusely and have large diameter stems.

Coleoptile color is reported as purple (Exhibit C, item 13), however, purpling is not intense nor does it involve the entire coleoptile.

Seedling anthocyanin is reported as absent (Exhibit C, item 14), however, traces of purpling are occasionally observed on seedling plants.

Exhibit EStatement of the Basis of Applicant's Ownership

The originating complex cross, early line evaluation, selection, reselection, testing, purification and final multiplication were all performed by the applicant breeder (Dr. H. N. Lafever) or his technical assistants on the property of The Ohio State University, Ohio Agricultural Research and Development Center utilizing funds provided for such research. The variety is intended for release as a public variety in the United States.

The Ohio State University
Ohio Agricultural Research and Development Center
Wooster, Ohio

RELEASE OF CARDINAL SOFT RED WINTER WHEAT

The Ohio State University, Ohio Agricultural Research and Development Center announces the release of 'Cardinal' soft red winter wheat, a new, highly productive cultivar.

Cardinal (previously designated OH 244) resulted from the complex cross: Logan 2*/3/Va63-52-12/Logan//Blueboy. First selected in 1974 as an F₃ plant, Cardinal was reselected in 1981 in the F₁₀ generation. Breeder seed consists of the bulked progeny of 39 F₁₀ plants selected for uniformity in 1981 and succeeding years.

Cardinal was first tested in advanced trials in Ohio in 1981. At the end of the 1985 season it had been tested in 25 state-wide advanced trials over 5 years of testing. Cardinal also has been an entry in the Uniform Eastern Soft Red Winter Wheat Nursery since 1983.

Cardinal is an awnless cultivar with mid-season maturity. It is a moderately short cultivar averaging 5 cm shorter than Tyler, 2.5 cm shorter than Hart and Titan, and 12.5 cm taller than Becker. Cardinal has exhibited excellent straw strength in Ohio and region-wide tests exceeding all currently grown cultivars except Becker and GR855 in straw strength. Winterhardiness of Cardinal is excellent, equaling that of the best currently grown cultivars in Ohio tests and exceeding numerous soft wheat cultivars except Charmony in severe tests in the upper Midwest.

Test weight of Cardinal is high, averaging .5 lb/bu below that of Hart. The yield record compiled by Cardinal is outstanding (Tables 1-3).

The USDA Soft Wheat Quality Laboratory, Wooster, Ohio in evaluations of samples of Cardinal has found it to possess excellent milling and baking quality (Table 4).

Cardinal possesses excellent resistance to leaf rust (Puccinia recondita) but is only moderately resistant to powdery mildew (Erysiphe graminis). It is also very resistant to wheat spindle streak mosaic virus (WSSM). Cardinal possesses resistance to Races A and C only of Hessian fly (Mayetiola destructor).

Cardinal has dark green foliage. At maturity its fusiform heads are held mostly erect and possess white chaff.

Application for Plant Variety Protection under the certification option will be made for Cardinal. The classes Foundation, Registered, and Certified will be allowed beyond Breeder seed.

-2-

Breeder seed of Cardinal will be maintained by the Ohio State University, Ohio Agricultural Research and Development Center, Wooster, Ohio, 44691. Seedings for the production of Foundation generation seed were first made in Ohio, Indiana, and Illinois in the fall of 1985.

Release of information to the general public regarding the name, release or description of Cardinal may be made at any time.

Frederick E. Hutchinson
Fred Hutchinson, Director
The Ohio State University
Ohio Agricultural Research and
Development Center

April 23, 1986
Date

Table 1. Comparative yields of Cardinal and currently grown cultivars in drilled plot trials by years, Ohio.

Entry	1981 3 tests	1982 3 tests	1983 7 tests	1984 6 tests	1985 6 tests	Avg. 22 tests	Avg. 25 tests
Adena	55.9	63.1	58.1	57.7	76.4	63.7	62.7
Becker	57.3	66.3	63.5	56.5	83.3	67.4	66.2
GR855	54.9	66.7	61.9	56.5	77.4	65.3	64.1
Hartl	56.4	68.9	57.7	55.3	78.3 ¹	64.2	63.3
Titan	58.0	62.3	60.1	51.3	77.9	62.9	62.3
Tyler	-	70.2	64.2	57.5	75.3	66.2	-
Cardinal	60.6	64.9	64.3	63.5	84.0	69.5	68.5
Arthur	48.3	61.8	-	-	-	-	-
Caldwell	58.6	60.9	-	-	-	-	-

¹ No 1985 data. Adjusted avg.'s based on relative performance in remaining years.

Table 2. Comparative yields of Cardinal and currently grown cultivars in drilled plot trials by locations, Ohio.

Entry	OARDC 1982-85	N.W. Br. 1982-85	W. Br. 1982-85	Mah. Co. 1983-85	S. Br. 1983-85	O.F.S. 1983	Vg. Cr. Br. 1983-85	Avg. (22 tests)
Adena	64.3	80.6	48.9	50.4	55.8	51.9	85.0	63.7
Becker	70.6	79.6	51.1	59.6	60.3	50.1	89.2	67.4
GR855	71.8	79.7	43.2	57.1	56.2	48.2	90.0	65.3
Hartl ¹	66.0	77.7	47.7	56.3	55.7	52.6	85.9	64.2
Titan	64.4	71.4	45.8	59.0	58.6	51.4	84.3	62.9
Tyler	72.3	81.5	47.8	53.7	54.0	57.6	89.8	66.2
Cardinal	71.8	86.2	51.0	58.1	62.5	53.9	92.8	69.6

¹ No 1985 data. Adjusted avg.'s based on relative performance in remaining years.

Table 3. Comparative performance of Cardinal and currently grown cultivars in drill plot trials, Ohio, 1981-1985. (Average of 22 tests)

Entry	Winter Survival (%)	Pl. Height (in.)	Date Headed (May)	Lodging (%)	Test Wt. (lb/bu)
Adena	97	32	25.2	6	58.2
Becker	95	31	26.5	1	56.9
GR855	96	31	24.1	1	55.6
Hart ¹	96	37	25.1	2	58.9
Titan	92	37	29.1	11	57.8
Tyler	97	38	26.0	6	57.9
Cardinal	97	36	26.9	2	58.4

¹ No 1985 data. Adjusted avg.'s based on relative performance in remaining years.

Table 4. Comparative insect, disease, aluminum tolerance, and quality ratings of Cardinal and currently grown cultivars in miscellaneous Ohio tests.

Entry	H.F. Res.	% Mildew 8 tests- 5 yrs.	WSSM ² 5 tests- 4 yrs.	Leaf Rust 6 tests- 3 yrs.	Al. tolerance		Quality (3 yrs.) Milling Baking	
					Yield ratio (% of Seneca) 3 yrs.	Visual score ³ 5 yrs.		
Adena	G.P.	37	1	19 MR-MS	74	5	A+	A
Becker	A,C	73	1	5 MR	58	4	B	A-
GR855	A,C	1	1	43 MS	82	5	C	B
Hart ¹	A,C	77	1	53 MS-S	40	7	C	D
Titan	A,C,	37	2	17 MR	71	4	C	D
Tyler	None	0	1	56 MS-S	--	4	A	D
Cardinal	A,C	39	1	0 VR	98	4	A+	B+

¹ No 1985 data. Adjusted avg.'s based on relative performance in remaining years.

² 0 = none to 9 = severe.

³ 0 = very tolerant to 9 = very sensitive.

Table 5. Results of state-wide drilled plot yield trials including Ohio advanced wheat lines, 1986. (In order by average yield in 6 tests.)

Entry	Yield (bu/a)										Survival (%)	Avg. Date Headed (May)	Avg. Pl.Ht. (in.)	Avg. Lodg. %	Leaf Rust2 (lb/bu)	Avg. Test Wt.
	OARDC (Wooster)	N.Western Br. (Custar)	Western Br.(S. Cha'ston)	Mahoning Co. Farm (Canfield)	Veg.Crops Br. (Fremont)	Southern Br. (Ripley)	Avg. Yield 6 Tests									
OH 257	59.6	78.0	61.2	55.8	67.6	43.4	60.9	96	21	35	6	1VR	56.5			
OH 328	55.1	72.3	66.9	51.5	80.8	35.0	60.3	97	19	34	18	5MS	56.0			
Tyler	58.5	67.5	57.6	56.0	72.0	32.9	57.4	93	19	37	13	20S	55.1			
Becker	53.4	66.0	70.7	38.1	76.8	37.6	57.1	95	19	31	5	5MR	54.0			
OH 285	54.4	68.3	65.4	47.2	62.4	42.9	56.8	94	18	36	5	1VR	56.3			
OH 265	57.0	73.3	72.6	41.4	61.0	33.7	56.5	95	18	34	10	OVR	55.1			
Cardinal	53.6	70.9	63.9	43.5	61.0	39.9	55.5	92	19	36	7	1R	55.9			
Hart	48.3	66.3	62.6	43.0	65.1	43.8	54.9	95	17	34	7	40S	55.7			
Titan	52.0	62.8	66.3	48.9	70.3	26.9	54.5	95	22	38	22	3MS	55.3			
GR 860	51.4	63.9	60.4	38.8	64.4	46.4	54.2	94	14	31	2	OVR	56.6			
Caldwell	51.0	69.4	64.9	41.0	63.6	34.4	54.1	95	15	34	18	OVR	54.2			
OH 286	49.7	64.1	72.2	39.7	58.8	33.6	53.0	95	19	33	4	1VR	51.8			
OH 2621	47.6	66.2	71.6	38.2	56.4	28.5	51.4	96	17	32	4	OVR	52.4			
OH 2941	47.7	63.0	69.2	37.9	55.9	30.4	50.7	96	17	33	6	1VR	53.1			
GR 863	48.9	69.8	58.4	38.1	54.0	33.2	50.4	94	15	29	2	1R	54.1			
OH 3081	53.9	63.5	58.1	39.2	56.7	30.9	50.4	92	15	32	2	20MS	54.2			
5% L.S.D.	3.0	7.3	7.5	5.3	10.5	3.6										

1 Denotes lines dropped from breeding program following 1986 season.
2 % - class (OARDC, Wooster, only).

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Quality Evaluation of Cardinal

(Data taken from U.S.D.A. Soft Wheat Quality Laboratory Reports)

Soft wheat quality tests of composite samples of 13 lines and varieties grown at 6 locations in 1985 in Ohio revealed Cardinal received a combined quality score of 101.9. Comparative scores for Adena, Becker, Titan, and Tyler were 88.9, 100, 81.7, and 82.1, respectively.

In evaluations of composite samples of 14 lines and varieties grown at 6 locations in Ohio in 1984, Cardinal (OH 244) received a combined quality score of 103. Comparative scores of Adena, Becker (OH 234), Hart, Tyler, and Titan were 100, 85, 78.3, 70.5, and 60.9, respectively.

In evaluations of composite samples of 16 lines and varieties grown at 7 locations in Ohio in 1983, Cardinal (OH 244) received a combined quality score of 97.3 while Adena, Becker (OH 234), Hart, Titan, and Tyler received combined scores of 100, 92, 89.7, 85.7 and 79.9, respectively.

No 1986 quality data is yet available.

These and other tests reveal that the baking and milling quality of Cardinal is excellent as a soft red winter wheat.

(See attached Tables 1-3)

Table 1. Wheat, milling, and flour analytical and baking data, and quality scores.
Drill plot entries from Wooster, Ohio, 1985 crop.

ADVANCED NURSERY EVALUATION

FOR SOFT WHEAT MILLING AND BAKING QUALITY

WOOSTER, OHIO

STANDARD = 85789, BECKER

LAB NO.	ENTRY	MILLING QUALITY SCORE	BAKING QUALITY SCORE	COMB. QUALITY SCORE	MICRO TEST WT KG/HL	SOFTNESS EQUIV.	FLOUR YIELD	ASH	FLOUR PROTEIN	MICRO AMRC	COOKIE DIAMETER	TOP GRAIN
****	STANDARD	100 A	100 A	100 A	77.3	66.8	76.2	.38	6.8	52.4	17.7	7
****	BENCHMARK	88.7 D	95.1 B	88.7 D	78.6	61.4*	73.5*	.35	7.9 *	52.9	18.2	7
788	ADENA	104 A	88.9 D	88.9 D	79	63.6	77.3	.35	7.7 *	52.7	17.5	3*
789	BECKER	100 A	100 A	100 A	77.4	66.8	76.2	.38	6.8	52.4	17.7	7
790	CARDINAL	104.4 A	101.9 A	101.9 A	80.1	62.2*	78.2	.33	7.3	51.6	18.0	6
791	TITAN	100 A	81.7 E	81.7 E	78.9	65.7	75.9	.33	7.6 *	53.6	17.2*	6
792	TYLER	102.1 A	82.1 E	82.1 E	79.3	64	76.7	.33	7.3	52.9	17.1*	4*
793	OH 256	96.8 B	78.2 F	78.2 F	79.5	63.4	75.3*	.3	8.4 *	54.5*	17.4*	5
794	OH 257	101.8 A	71.5 F	71.5 F	80.5	61.2*	77	.32	8.4 *	55.8*	17.3*	6
795	OH 260	104.9 A	88.4 D	88.4 D	81.3	63 *	78	.34	8.8 *	52.1	17.6	5
796	OH 262	99.5 B	96.3 B	96.3 B	79.7	68.2	75.3*	.34	7.7 *	54 *	17.9	6
797	OH 265	102.2 A	86.5 D	86.5 D	81	63.8	76.7	.33	8.1 *	54.4*	17.7	7
798	OH 285	104.3 A	92.9 C	92.9 C	80.5	61.9*	78.4	.33	8.5 *	52.2	17.8	7
799	OH 286	102.6 A	93.2 C	93.2 C	79.1	69	76.1	.34	7.7 *	53.6	17.7	7
800	OH 308	96 B	84.8 E	84.8 E	80.6	64.8	75.4	.4	7.7 *	53.8	17.4*	5

LAB NO.	ENTRY	BREAK FLOUR YIELD	EXT.	E.S.I.
****	STANDARD	40.4	78.1	8.2
****	BENCHMARK	35.8*	75.6*	11.7*
788	ADENA	37.7	79.1	6.8
789	BECKER	40.4	78.1	8.2
790	CARDINAL	36.5*	79.9	5.7
791	TITAN	39.5	77.8	8.6
792	TYLER	38	78.5	7.6
793	OH 256	37.5	77.3*	9.4 *
794	OH 257	35.7*	78.8	7.2
795	OH 260	37.2*	79.7	5.9
796	OH 262	41.6	77.3*	9.4 *
797	OH 265	37.9	78.5	7.6
798	OH 285	36.3*	80.1	5.4
799	OH 286	42.3	78	8.4
800	OH 308	38.7	77.3	5.2

Table 2. Wheat, milling, and flour analytical and baking data, and quality scores. Drill plot entries from Wooster, Ohio, 1984 crop.

WHEAT AND MILLING DATA

LAB NO.	ENTRY	MILLING QUALITY SCORE	BAKING QUALITY SCORE	COMBINED QUALITY SCORE	TEST WT.	BREAK FLOUR YIELD	ST. GR. FLOUR YIELD	RED. PASSES	FRIABILITY	E. S. I. MILLABILITY
***	STANDARD BENCHMARK	100 A	100 A	100 A	62.7	29.8	76.4	7	28.4	11.1
***		105.9A	109.9A	105.9A	61.6*	35.6	76.3	7	28 *	10.4
057	ADENA	100 A	100 A	100 A	62.7	29.8	76.4	7	28.4	11.1
058	HART	92.8 C	78.3F	78.3F	62.6	32	74.40	7	27 Q	12.9*
059	TYLER	100 A	70.5F	70.5F	62.2	32.4	76.2	7	28.5	11.4
060	TITAN	93.6 C	60.9F	60.9F	62.7	33.6	74.8*	7	26.80	12.5*
061	OH 234	94.5 C	85 D	85 D	62.3	34	75.9	7	27.70	11.5
062	OH 235	95 B	98.2B	95 B	61.6*	30.5	76.1	7	28.2	10.8
063	OH244	106.5A	103.9A	103.9A	63.1	30.6	77.6	7	29.2	9.6
064	OH 256	93.4 C	78.4F	78.4F	62.2	32	75.4*	7	27.30	12
065	OH 257	97.2 B	69.9F	69.9F	63.1	26.80	75.9	7	27.70	11.6
066	OH 260	109.7A	93.6C	93.6C	64.8	31.9	77.9	7	29.3	9.5
067	OH 262	98.1 B	95.1B	95.1B	61.7*	30	75.6	7	28.6	11.8
068	OH 265	100.8A	89.5D	89.5D	63.1	35.8	76.3	7	29	11.4
069	OH 285	107.2A	113.9A	107.9A	63.4	29	77.5	7	29.8	9.3
070	OH 286	101.2A	97.2B	97.2B	61.8*	37.2	76.6	7	29.3	11

STRAIGHT-GRADE FLOUR

LAB NO.	FLOUR PROTEIN %	ASH %	MICRO AWRC %	COOKIE DIAMETER CM.	TOP GRAIN
***	9.74	.39	48.4	17.89	4
***	8.9	.35	51.3*	18.35	7
057	9.74	.39	48.4	17.89	4
058	10.90	.38	50.3*	17.56*	1*
059	9.01	.39	52.60	17.390	2*
060	10	.39	51.60	17.160	1*
061	9.18	.43*	49.7	17.57*	3
062	10.2	.43*	48.3	17.87	4
063	9.4	.39	47.9	17.91	4
064	10.2	.41	50.7*	17.64*	2*
065	10.4*	.38	50.4*	17.330	3
066	11.20	.38	48.2	17.82	3
067	9.38	.41	51 *	17.91	5
068	9.9	.41	51 *	17.81	3
069	10.1	.39	46.9	18.15	5
070	9.93	.42*	49.9	17.93	3

Table 3. Wheat, milling, and flour analytical and baking data, and quality scores. Drill plot entries from Wooster, Ohio, 1983 crop.

LAB NO.	ENTRY	MILLING QUALITY SCORE	BAKING QUALITY SCORE	COMBINED QUALITY SCORE	MILLAB. SCORE	TEST WT. KG/H.	WHEAT PROT. %	WHEAT ABM %	PBI %	EBI %	RED PASS YIELD	BREAK FLOUR YIELD	FLOUR YIELD	FAIR %
107 10	04260	103.8A	100.3A	100.3A	117.8	70.9	10.4*	1.6	30.6	9.1	0	31.9*	76.8	20.1
000	STANDARD	100 A	100 A	100 A	103.7	77	9.6	1.53	40.2	11.7	0	33.9	75.4	27.1
036 3	ADENA	100 A	100 A	100 A	103.7	77	9.6	1.53	40.2	11.7	0	33.9	75.4	27.1
110 13	04283	105 A	98.3 B	98.3 B	119.1	78.3	9.8	1.62	37.4*	9	0	30.7*	76.6	20.3
103 2	04244	107.6A	97.3 B	97.3 B	117.8	77.5	9.3	1.53	30.7	9.1	0	34.1	77	20.3
000	BENCHMARK	104.8A	96.2 B	96.2 B	112.5	79.3	9.6	1.45	39.2	10.4	0	35	76.6	27.6
103 12	04265	94.5 C	94.2 C	94.2 C	90.5 *	77.3	9.2	1.69	44.1	12.1	0	30.3	74.5*	26.3
111 15	04286	92 C	92.4 C	92.5 C	87.9 *	76.3	9.1	1.69	43.2	12.3	0	39	74.4*	26.3
101 4	04234	90.5 C	93 C	93 C	87.1 *	76.9	10	1.67	39.4	12.1	0	34.2	73.60	25.3
105 8	04256	93.2 C	90.5 C	89.8 D	95.7	76.5	9.7	1.64	38.2*	11.6	0	33.7	74.9	26.6
102 6	04235	89.7 D	90.5 C	89.7 D	91.4 *	76.2*	10.3*	1.65	40	12.7	0	34.6	73.50	25.9
037 11	MARY	94.3 C	88.2 D	88.2 D	96.4	77.3	10.3*	1.64	46.9	11.4	0	35.4	75.4	25.4
100 16	04262	87.1 D	96.9 B	87.1 D	88.2 D	75.7*	9.5	1.65	44.7	13.6*	0	39.3	73.8*	25.4
030 5	TITAN	91.8 C	85.7 D	85.7 D	90.6 *	76.7	9.6	1.65	39.7	12.9*	0	36.6	73.9*	25.9
034 14	TYLER	102.7A	79.9 F	79.9 F	108.2	77	9	1.5	39.1	11.6	0	34.8	75.6	27.0
104 7	04255	78.8 F	87.1 D	78.8 F	79.1 D	78.2	10.80	1.71*	36.40	13.8*	0	31.7*	72.70	24
106 9	04257	86.8 D	74 F	74 F	96.9	78.3	10.80	1.74*	33.50	12	0	29.80	75.2	26.4

STRAIGHT-GRADE FLOUR

LAB NO.	PROT. %	ABM %	ADJ. MACM. VISC.	MICRO AMRC %	COOKIE DIAM. CM.	TOP GRAIN
107	9.1	.36	67	47.7	10.67	7
000	7.0	.36	91	48.0	10.31	7
036	7.8	.36	91	48.0	10.31	7
110	8.5	.35	55	49.1	10.7	7
103	7.8	.37	10	48.5	10.21	6
000	8.5	.36	85	50.6*	10.57	3*
103	7.7	.40	97	51.5*	10.25	6
111	7.8	.410	11	51.4*	10.17	6
101	7.4	.40	82	51.5*	10.12	6
105	8.6	.37	97	50.1	10.32	6
102	8.1	.39*	59	49.4	10.06*	7
037	6.6	.36	70	50.7*	10.22	6
100	9	.39*	91	52.30	10.26	5
100	7.8	.410	10	50.6*	10.25	6
030	8.4	.37	84	51.3*	10.00	6
033	7.6	.35	13	50.8*	17.690	5
104	9.3	.37	73	49.6	10.22	6
106	9	.30*	70	50.4*	17.05*	6

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